PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 14 (6): 322-324, 2015
ISSN 1680-5194

Nutritive Values and Metabolizable Energy of *Amorphopallus companulatus* Fermented by *Rhyzopus oligosporus* as Poultry Feed

Theresia Nur Indah Koni, Agustinus Paga, Redempta Wea and Tri Anggarini Foenay
Department of Animal Science, Kupang State Agricultural Polytechnic,
Kupang, East Nusa Tenggara, Indonesia

Abstract: An experiment was conducted to evaluate the effect of *Rhizopus oligosporus* dosages on the nutritive values and metabolizable energy of *Amorphopallus companulatus*. This experiment was arranged in a Completely Randomized Design (CRD) with four treatments and five replicates. The treatments were 0, 0.3, 0.6 and 0.9% dosage of *R. oligosporus* inoculum. The parameters observed were dry matter, crude protein, crude fiber and metabolizable energy of fermented *A. companulatus*. Results showed that the crude protein content of 0.6% inoculum were significantly higher ($p<0.05$) than 0.3 and 0.9%. Crude fiber, ether extract content and metabolizable energy were not affected by the treatments.

Key words: Fermentation, *A. companulatus*, nutritive value, metabolizable energy

INTRODUCTION

Maek (*Amorphopallus companulatus*), commonly known as elephant foot yam, is a bulbous plant, which is native to tropical areas. It belongs to the family of Araceae. In this research weight of *A. companulatus* tubers can be up to 5 kg; 5-15 kg in Siddha India (Firdouse *et al*., 2012). The tuber is widely used in many ayurvedic preparations and prescribed in liver diseases, bronchitis, asthma, abdominal pain, emesis, dysentery, enlargement of spleen, piles, elephantiasis, diseases due to vitiated blood and rheumatic swellings (Ansil *et al*., 2012). It contains about 7.56% crude protein, 13.72% crude fiber, 0.29% ether extract (Gumilar *et al*., 2014).

Inclusion of 10% *Amorphopallus* sp. in the rat ration can reduce plasm cholesterol (Harijati *et al*., 2011). Wizna *et al*. (2009) stated that chicken's digestive tolerance to crude fiber was very low and the limit of crude fiber content in broiler chicken feed was 2-5%. A feedstuff with high crude fiber content such as *amorphopallus* tubers, should be processed before using in chicken's ration to decreased the crude fiber content.

Improving nutrient content may use variety of processing method, such as chemical, physical and biological process. Biological process use microbes to ferment feed, for example tempeh mould, which is mostly consisted of *Rhyzopus oligosporus* (Kovac and Raspor, 1997). *R. oligosporus* was able to increase crude protein content of banana peel up to 54.02% (Cipta and Mirnawati, 2001) and reduce crude fiber content until 15.82% (Koni *et al*., 2013). Since the fermentation can be used in reducing crude fiber of banana peel, the use of this method may improve the nutritive value and energy metabolism of *A. companulatus* as poultry feed. The present research was aimed to investigate the effect of *Rhyzopus oligosporus* dosages in fermentation of *A. companulatus*on crude protein, crude fiber, extract ether and metabolizable energy.

MATERIALS AND METHODS

Fermentation: Maek tubers were cleaned, peeled and cutting 7 cm length, then steamed for 10 min. The maek was removed from steamer and allowed to cool before inoculating. Cooled maek was mixed with different dosages of *Rhyzopus oligosporus* until homogenous. The mixture was packaged in plastic bag which has perforated holes, then incubated at room temperature for 48 h.

Research methods: Completely Randomized Design (CRD) was employed in this experiment. The treatments were dosages of *Rhyzopus oligosporus* (RO): 0, 0.3, 0.6 and 0.9%. The total amount of substrate used for each replication was 1.000 g. Measured variables were nutrient contents crude fiber, crude protein, ether extract and metabolizable energy content. Crude protein, crude fiber and ether extract were determined according to proximate analysis procedures (AOAC, 1990). Metabolizable energy were performed according to Ezieshi *et al*. (2011). Data were analyzed by analysis of variance of CRD Duncan Multiple Range Test (DMRT) according to Steel and Torrie (1989) was performed to testing the difference among treatments.

RESULTS

Effect of treatments on dry matter, crude protein, crude fiber, ether extract, ash and metabolizable energy of fermented *A. companulatus* by *R. oligosporus* were illustrated in Table 1. The result showed that dry matter

Corresponding Author: Theresia Nur Indah Koni, Department of Animal Science, Kupang State Agricultural Polytechnic, Kupang, East Nusa Tenggara, Indonesia

Table 1: Proximate composition and metabolizable energy of *A. companulatus*

	---------------- Dosage of *R. oligosporus* ---------------			
Nutritive value	(0%)	0.30%	0.6%	0.0%
Dry matter (%)	89.756[a]	88.906[b]	88.552[bc]	88.100[c]
Crude protein (%)	7.332[a]	7.666[ac]	10.302[b]	8.000[c]
Crude fiber (%)	4.052	4.396	4.698	4.978
Ether extrat (%)	1.040	2.240	2.436	2.458
Ash (%)	13.206[a]	12.728[a]	9.332[b]	7.700[b]
Metabolizable energy (kcal/kg)	2831.96	2906.65	2958.62	2989.82

[a,b,c]Means on the same row with the same superscripts are not significantly different (p>0.05)

contents is significantly (p<0.01) decreased with the increasing of dosage of *R. oligosporus*. Dry mater of 0 dosage was higher than other treatments. Dry matter of 0.3 and 0.6% dosage were no differed (p>0.05), but significantly higher (p<0.05) than 0.9% dosage. Treatment 0.6 and 0.9% dosage were no differed.

The result of the analysis of variance indicated tha crude protein content of *A. companulatus* was significantly (p<0.05) influenced by the treatments. Fermentation caused increasing in protein content as reflected in Table 1. The crude protein content of 0% dosage of *R. oligosporus* was not differed from 0.3% dosage, but significantly lower (p<0.05) than 0.6 and 0.9% dosage. The crude protein content of 0.3% dosage was not differed from 0.9% dosage, but significantly lower than 0.6% dosage. However, the crude protein content of 0.6% was significantly higher (p<0.05) than other treatments.

As shown in Table 1, crude fiber content, ether extract and metabolizable energy of *A. companulatus* was not significantly affected (p>0.05) by the treatments. On the other hand, the ash content of *A. companulatus* was significantly affected (p<0.05).

DISCUSSION

Increasing of dosage of *R. oligosporus* decreased the dry matter content of *A. companulatus*. The decline of dry matter content was mostly due to the activity of *R. oligosporus* that used organic matter from substrate (*Amorphophalus*) as carbon sources for growing and since the metabolism process changed the carbon sources into carbon dioxide, water and energy, then the higher dosages of *R. oligosporus* produced greater number of microbes and leads to enhancement of water production as one of metabolic product which cause the decreasing of dry matter content. This result was similar to Haryati and Sutikno (1994) who pointed out that decreasing of dry matter content on fermented feed was the result of metabolism activities.

The crude protein content of *A. companulatus* was considerably increased and this increasing might be due to reduction of other nutritive value. The crude protein content of *A. companulatus* with 0.3, 0.6 and 0.9% dosages of *R. oligosporus* were higher than that on 0% dosage. This result was in line with Almasyhuri *et al.* (1999) who reported that the increasing of crude protein content of cassava peel fermented by *R. oligosporus* from 2.1 to 4.7%.

The higher crude protein may be caused by the growing of *R. oligosporus* and its cell contribute in increasing crude protein. Bod'a (1990) reported that fungi contained more than 20% crude protein. Increasing of crude protein content of substrate after fermentation might be caused by the process of protein enrichment, which combined from the microbes protein of *R. oligosporus* and protein of substrate (*A. companulatus*) (Haryati and Sutikno, 1994). Kovac and Raspor (1997) also stated that mycelia coloni of *R. oligosporus* produce proteases, lipases, phytases and varieties of carbohydrate.

Crude fiber content of fermented *A. companulatus* has no significant (p>0.05) effect by dosage of *R. oligosporus*. The higher crude fiber which increased in fermentation using *R. oligosporus* was caused by cell wall of *R. oligosporus* that contain *chitin*. Chitin is similar with crude fiber in plant cell. This result differed with Al-Arif (2001) who reported decreasing of crude fiber content of coconut pulp and rice brand from 23.99 to 19.54%.

Ether extract of fermented *A. companulatus* was no significantly (p>0.05) effected by dosage of *R. oligosporus*. There was increasing trend by increasing dosage. It was caused lipase enzyme activity of *R. oligosporus*. According to Gadjar (1995) tempeh mould was known a microbe which produce lipase, protease.

Fermentation significantly (p<0.5) decreased the ash content of *A. companulatus*. It might be associated with the mineral utilization by *R. oligosporus* for growing. This result was contradict with Paredes-lopez *et al.* (1990) who reported ash content relatively stabile on tempeh fermentation.

The increasing of metabolizable energy was the result of fermentation process that improve the digestibility of feed that supplied simple carbohydrates, which was used by animal as energy sources.

Conclusion: Nutritive value and metabolizable energy of fermented *A. companulatus* using *R. oligosporus* was significantly increased at 0.6% dosage. This fermentation process was able to increase crude protein up to 41.10% and the nutritional value of *A. companulatus* was 88.55% dry matter, 10.30% crude protein, 4.69% crude fiber, 2.44% ether extract, 9.33% ash and 2958.62 kcal/kg metabolizable energy.

ACKNOWLEDGMENTS

This experiment was funded by Hibah Bersaing Project 2014 from Directorate General of Higher Education, Department of National Education Republic of Indonesia.

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